Mud Creek Project
Fuels Treatment Prioritization and Proposed Activity Identification Process

Fuels treatment prioritization and the identification of proposed activities for the Mud Creek Project was completed in two parts. The first part of this document describes the process used to identify priority areas for potential fuels treatments within the Mud Creek project area using criteria that aligns with the goals of the National Cohesive Strategy for Wildfire. The second part documents the process for identifying the proposed treatments. The process utilizes existing forest types and historical fire regime information to provide context for identifying potential treatment activities that will improve vegetation and fuels conditions resulting in a landscape and community that is resilient to fire disturbances.

The Mud Creek Project is being designed to be consistent with the National Cohesive Strategy. The National Strategy recognizes and accepts fire as a natural process necessary for the maintenance of many ecosystems, and strives to reduce conflicts between fire-prone landscapes and people. By simultaneously considering the role of fire in the landscape, the ability of humans to plan for and adapt to living with fire, and the need to be prepared to respond to fire when it occurs, the Cohesive Strategy takes a holistic approach to the future of wildland fire management.

The primary, national goals identified as necessary to achieving the vision are:

> ***Restore and maintain landscapes:*** Landscapes across all jurisdictions are resilient to fire-related disturbances in accordance with management objectives.
>
> ***Fire-adapted communities:*** Human populations and infrastructure can withstand a wildfire without loss of life and property.
>
> ***Wildfire response:*** All jurisdictions participate in making and implementing safe, effective, efficient risk-based wildfire management decisions.

The natural resources within the Mud Creek Project area and the communities adjacent to the Bitterroot National Forest have long been and will continue to be affected by wildfire. These wildfires can result in significant, long-lasting impacts to ecological, social, and economic systems. Therefore, it is necessary to identify and understand the risks posed by wildland fire and to develop effective mitigation strategies accordingly.

The following process was used to identify the priority areas for fuels treatments. Prioritization focused on potential fire behavior as this can be used to measure landscape resiliency to fire disturbance based on historical fire regimes and directly relates to effectiveness during wildfire response. To determine potential impacts to the community it is necessary to know how likely they are to be impacted by fire, modeling results from the Bitterroot Wildfire Risk Assessment were used to simulate fire spread on the landscape.

Three criteria were chosen to conduct this assessment.

- *Where fires are the most likely to occur (Burn Probability).*
- *What are the fire effects and intensity should a fire occur under severe conditions (Crown Fire Percentage).*
- *Potential to impact communities (Distance to Structures & Ignition Density Weight).*

Where fires are the most likely to occur (Burn Probability).

Burn Probability- BP is the probability that a wildfire will burn a given pixel (90m x 90m or 2 acres) during a single calendar year. Annual BP is generally quite a low value— very often less than 0.01—making its expression as a fraction difficult to visualize or interpret. The mean burn probability was calculated at the stand level and then classified on a scale of 1-100 based on the individual stand's BP value. Stand with the highest BP received the highest ranking.

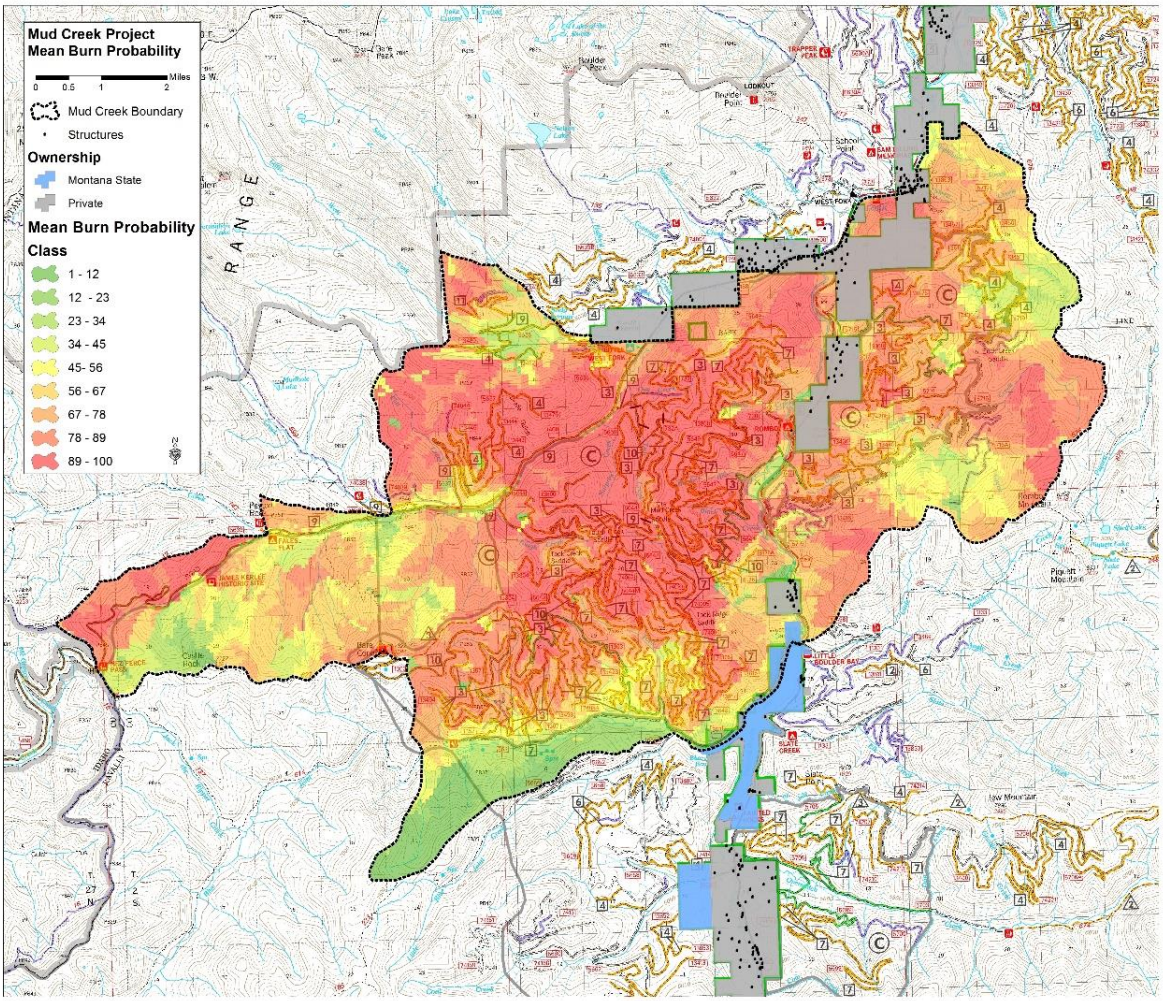

Figure 1. Mean Burn Probability

Table 1: Mean Burn Probability

Burn Probability Class	Acres	Percent of Project
1-12	1,386	3
12-23	938	2
23-34	1,252	3
34-45	2,866	6
45-56	3,660	8
56-67	5,450	11
67-78	8,867	18
78-89	12,153	25
89-100	11,839	24

What are the fire effects and intensity should a fire occur under severe conditions (Crown Fire Percentage).

Crown Fire Percentage- Existing condition fire behavior was modeled for the entire assessment area using severe burning conditions (97%) as specified in Table 1. This generated the potential fire type across the assessment area. The areas exhibiting passive and active were then joined to the forest stands layer and used to calculate the percentage of each stand with the potential for crown fire. Stands were then ranked and reclassified on a scale of 1-100 based on their crown fire percentage.

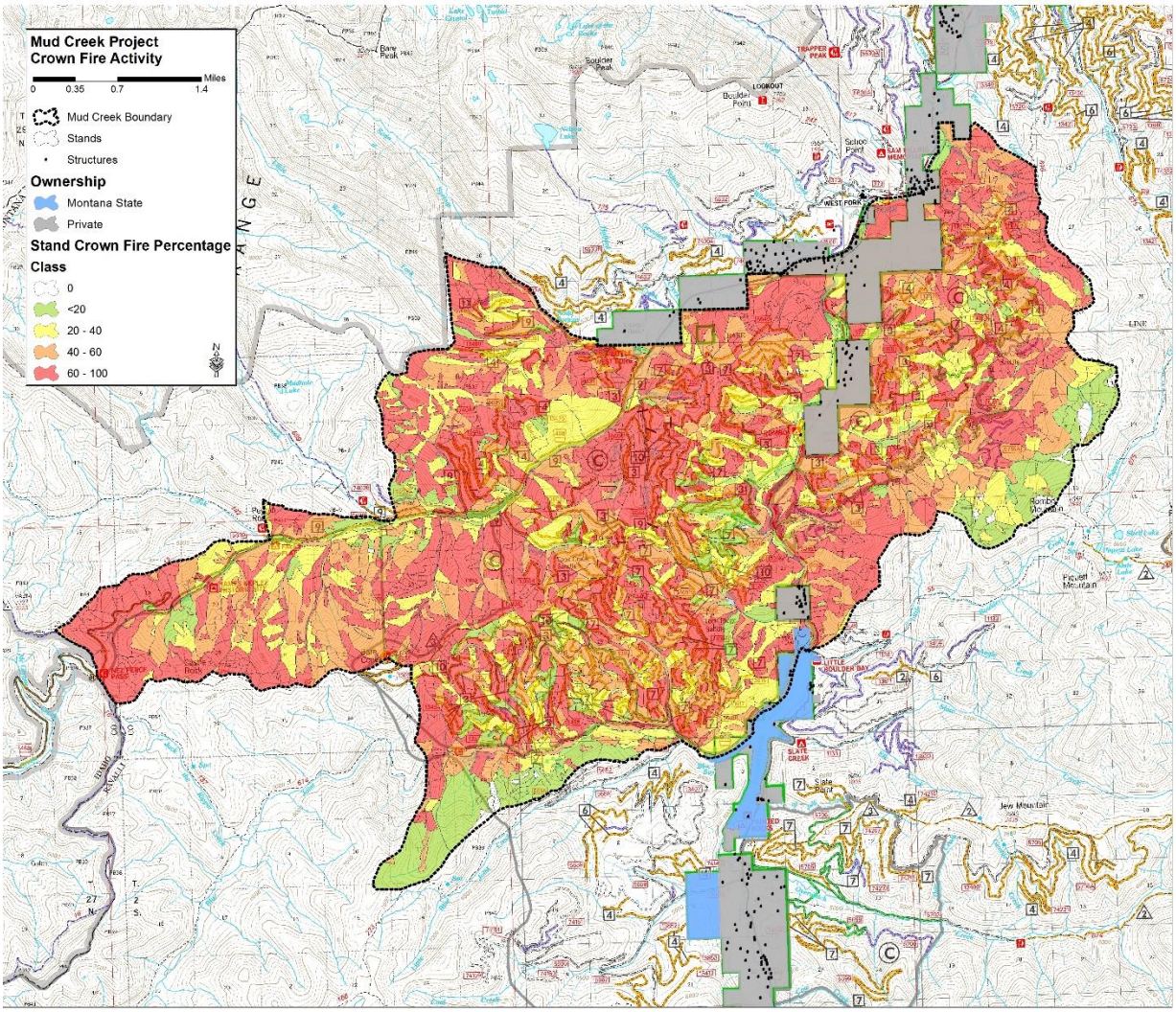

Figure 2. Stand Crown Fire Percentage

Table 2: Stand Crown Fire Percentage

Stand Crown Fire Class	Acres	Percent of Project
0-20	4,440	9
20-40	8,127	17
40-60	15,222	31
60-100	20,714	43

Potential to impact to communities (Distance to Structures).

Distance to Structures- In order to achieve the goal of fire adapted communities there needs to be a focus on creating favorable conditions in and around communities and structures. The Ravalli County structure layer was used to create a distance grid for the entire assessment area. This grid was then classified on a scale of 1-100 based on the proximity to structures. The closest areas received the highest rankings.

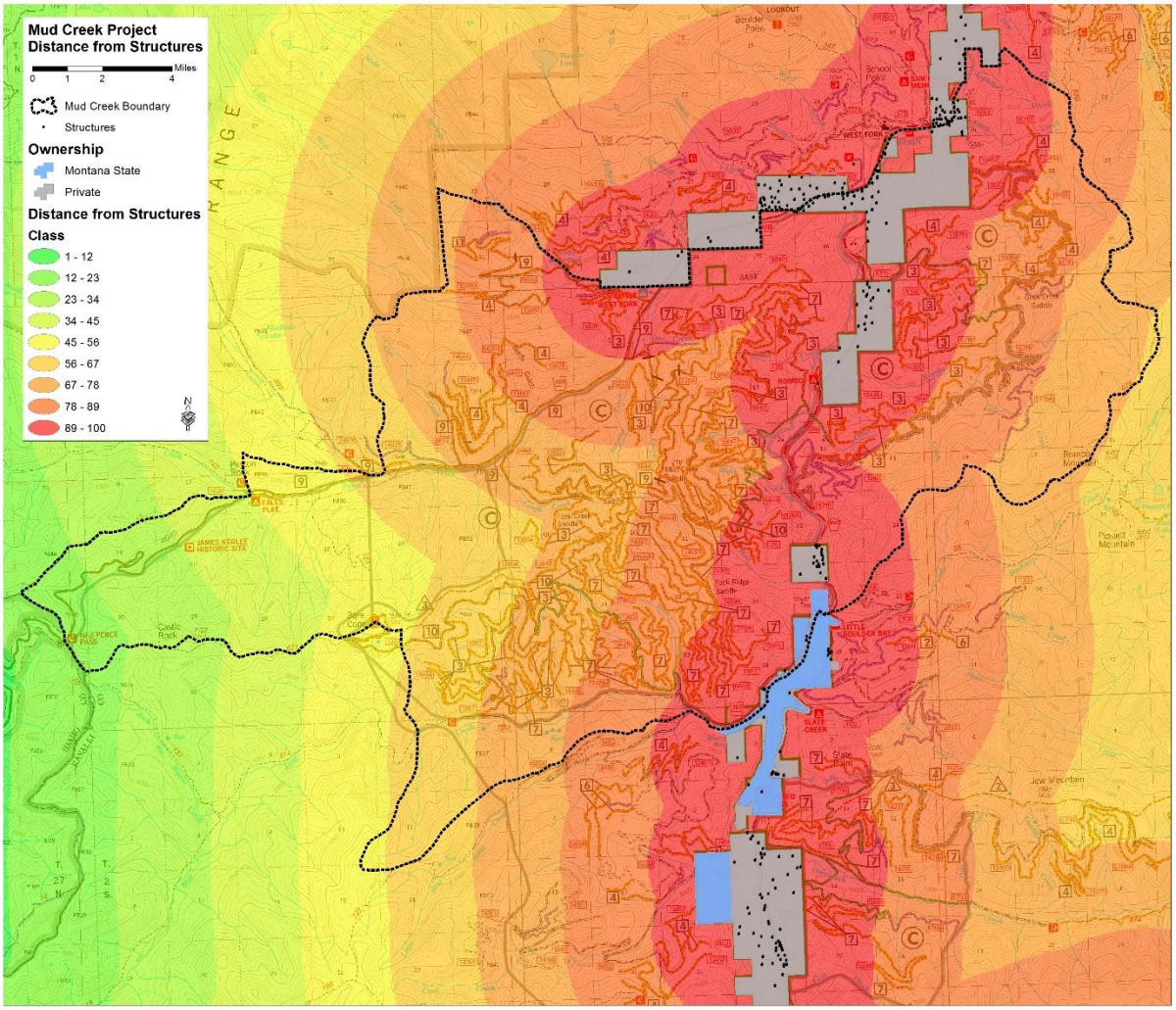

Figure 3. Distance from Structures

Ignition Density Weight- An additional weighting was added to stands based on their location within the Ignition Density-Community Protection layer. This was used to increase the importance of stands in which if a fire were to originate, had a probability to reach communities.

Table 3: Ignition Density Additional Weight

Ignition Density Probability	Additional Weight (Standard Deviation)
None	0
Very Low	24,375
Low	48,750
Moderate	97,500
High	146,250
Very High	195,000

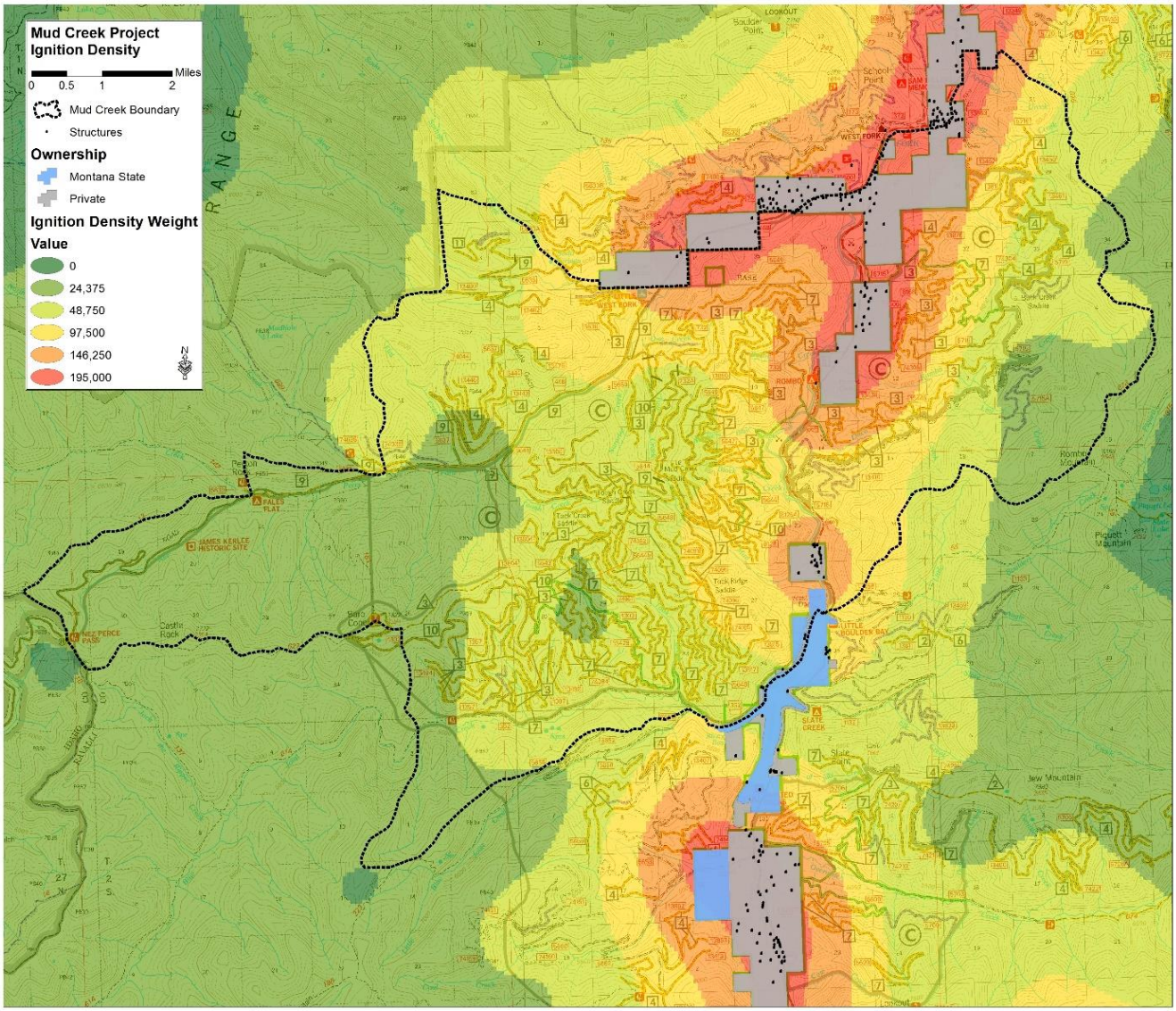

Figure 4. Ignition Density Weighting

Total Score = BP (1-100) * Crown Fire Percentage (1-100) * Distance to Structures (1-100) + Ignition Density Weight.

Fuels Treatment Priority was determined by classifying the total score into 3 separate classes based on natural breaks. Figure 5 below displays were the priority treatments are located throughout the assessment area.

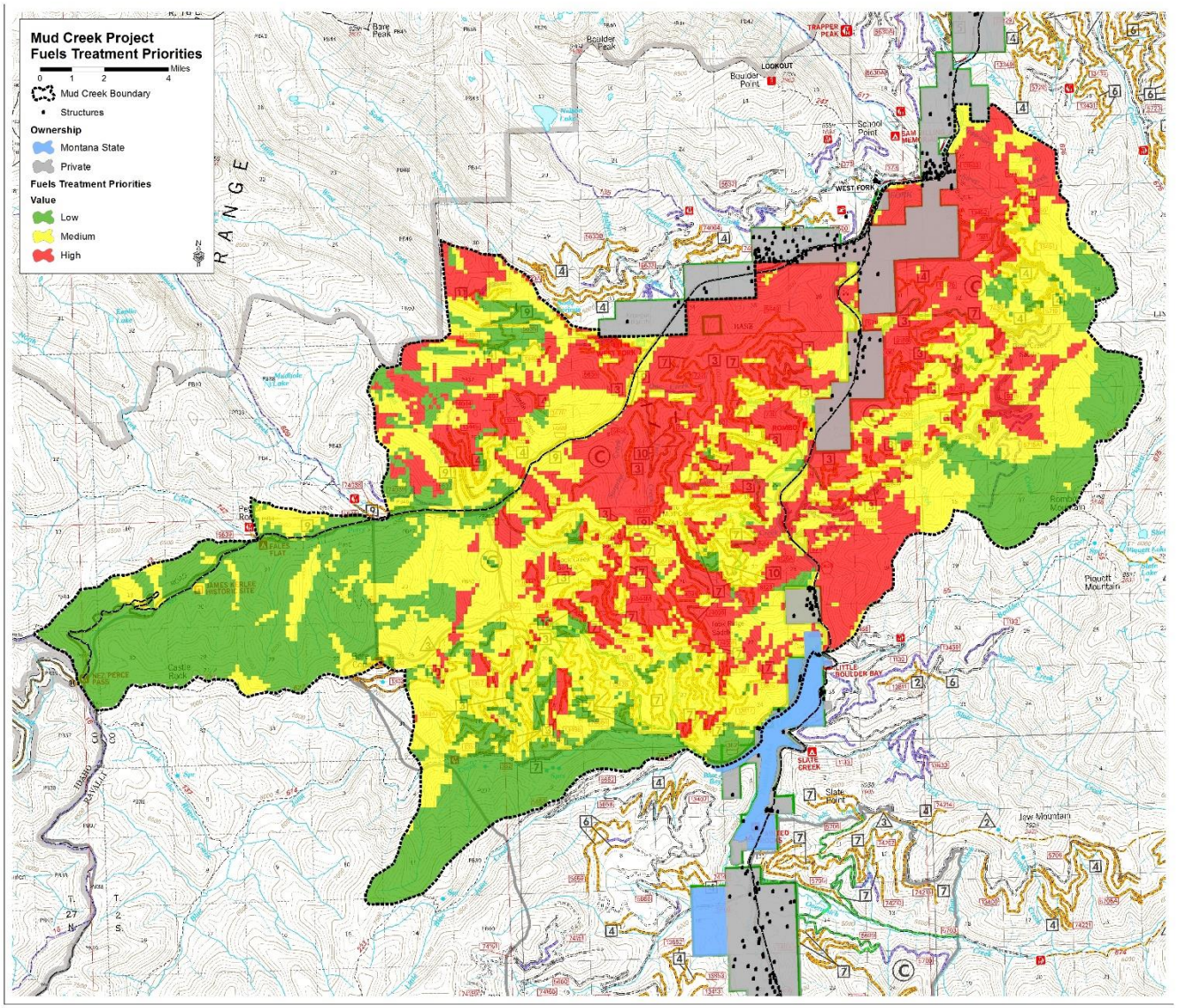

Figure 5. Fuel Treatment Priorities

Table 4. (Fuels Treatment Priorities)

Fuels Treatment Priority	Acres	Percent of Project
Low	12,936	27
Moderate	18,328	38
High	17,155	35

Mud Creek Treatment Activity Analysis

Historically fire was a frequent disturbance process within the Mud Creek Project. Fire exclusion has dramatically altered fire regimes, vegetation composition, structure and fuels. Since 1986 only 5,413 acres (11%) of the project area has experienced fire with the majority of the acres occurring in 2000 (3,072 acres) and 2007 (1,891 acres) in concentrated areas along the perimeter of the project area. Prior to those events that last large fire event was in 1889.

Arno (1976) found evidence in the West Fork and Tolan Creek drainages of the Bitterroot NF that fires of low-to-moderate intensity occurred most often over the landscape, with occasional stand-destroying fires. He found an average fire-free interval of 11-16 years in ponderosa and Douglas-fir and 16-27 years in Douglas-fir, lodgepole pine dominated sites during the period of 1734-1889.

The primary historical fire regimes within the assessment area had short to moderately short fire-free intervals, and were not typically stand replacing fires. Non-stand replacing fire regimes (Regimes I and III) represent about 79% of the project area and fire regimes with short fire return intervals (Regimes I, II) represent 74% of the area. Currently, 61% of area classified as Fire Regime I to be at high risk of stand replacing fire. Approximately 15% of the assessment area is classified as moderately short fire free intervals (Regime IV) but generally burned with stand replacing fires. These areas are located in the upper elevations of the project area.

Table 5: Fire Regime Groups

Natural Fire Regime	Frequency (Mean Fire Return Interval)	Vegetation Severity	Portion of Assessment Area[1]	Description
I	0-35 years,	Low/Mixed	68% (31,892 Ac.)	Fires in Regime Group I generally create open stand conditions with small inclusions of higher density. Understories are generally sparse. Forest gaps result when individual trees and small groups of trees are killed. Localized, heavy accumulations of fuels heat some tree boles and roots to lethal temperatures. Stand-replacing fires result when heavy accumulations of fuel are contiguous throughout the stand.
II	0-35 years,	Stand Replacing	6% (2,603 Ac.)	Fire Regime Group II, found in grass and shrub types, is similar in fire frequency to forested communities; although the intensity is much greater. Fire top-kills stands of grass and willow, but causes a "stand-replacing" effect in bitterbrush and mountain mahogany. In the grassland and willow communities, vegetation development often occurs from the re-sprouting of existing plants. Bitterbrush and mountain mahogany however, rarely resprout and fire in this community results in seral stages that are dominated by grasses and forbs

Natural Fire Regime	Frequency (Mean Fire Return Interval)	Vegetation Severity	Portion of Assessment Area[1]	Description
III	35-200 years,	Mixed/Low	11% (5,073 Ac.)	Fire Regime Group III has a longer fire return interval than Groups I and II. Because disturbance occurs less often, vegetative density increases and fuel accumulates, resulting in fires of greater intensity and severity than Groups I and II. Larger areas of mortality generally result, creating more diversity in age and size classes on the landscape.
IV	35-200 years,	Stand Replacing	15% (6,779 Ac.)	Fire Regime Group IV has a similar fire frequency as Group III; however, fires generally result in greater mortality because stand densities in lodgepole pine communities, the dominant vegetative type in this fire regime, are higher than those found in the drier vegetative communities in Group III. Additionally, lodgepole pine, due to its thin bark, is less resistant to fire than those species found in Group III. Arno (1976) noted that large fires in the lodgepole pine communities and spruce-fir types historically resulted from a combination of high fuel loading, drought, and wind. He also noted that non-lethal fire may have occurred in lodgepole pine forests at some time between the stand replacing events, possibly at intervals as short as 40-80 years.
V	200+ years	Stand Replacing	<1% (211 Ac.)	Fire Regime Group V generally has a much longer return interval than the other groups. Generally replacement-severity but can include any severity type in this frequency range.

The lack of fire within the project area has had major changes to the natural fire regimes. Fire regimes have been moderately to highly altered from their natural (historical) range. Risk of losing key ecosystem components is moderate to high. Fire frequencies have departed from natural frequencies by one or more return intervals (decreased). Dramatic changes to one or more of the following are expected to occur: fire size, intensity and severity, and landscape patterns. Vegetation and fuel attributes have been moderately to substantially altered from their natural (historical) range. Approximately 83% of the project area has a moderate to high vegetation departure from historic conditions (LANDFIRE, VCC).

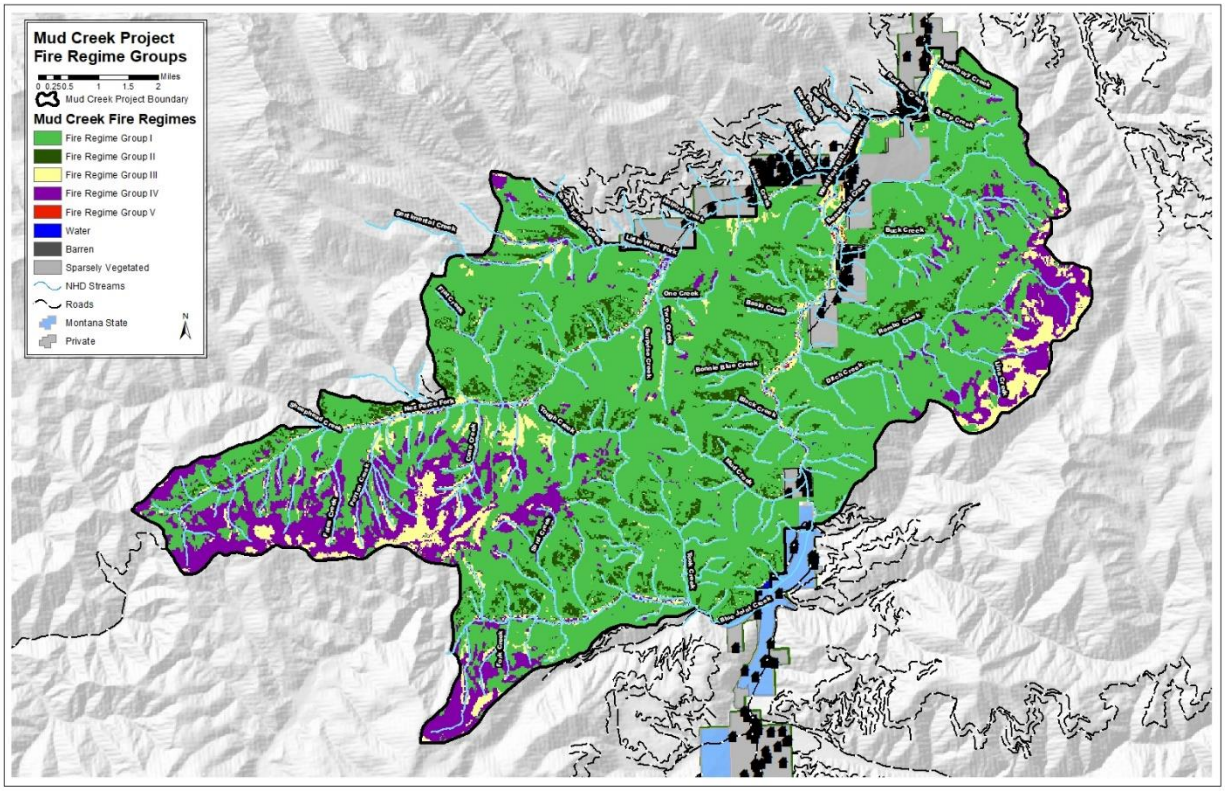

Figure 6. Fire Regime Groups

Prescribed Fire Opportunities

Low Severity/High Frequency Fire Regimes

The greatest departure is within the warm dry forest types that historically had frequent low intensity fire. Warm Dry forest types and dry grass comprise 31,911 acres or 68% of the project area. Historically, 74% of the project area is classified as being within Fire Regime Groups I and II. The difference between these percentages is caused by approximately 1,865 acres which are classified as transitional or non-forested because of effects from past wildfires or vegetation management. The majority of these acres would have been classified as warm dry prior to that disturbance. The following criteria was used to filter out areas where low intensity prescribed fire would be an appropriate activity to reduce fire behavior, protect communities, restore or maintain desired vegetation conditions and provide resilience to disturbance processes on the landscape.

Where are warm dry forest types and dry grass located?

- Within the Mud Creek Project Area 31,502 Acres are classified as Warm Dry Forest and 409 acres are classified as dry grass. These areas are dominated by ponderosa pine, dry-Douglas-fir and open grasslands.

Exclude RHCA's from prescribed fire to protect water quality and aquatic habitat.

- A 50' buffer on either side of the NHD stream layer was used. Utilizing this filter ensures compliance with the fisheries design feature for prescribed fire that prohibits direct ignition within 50' of streams.

Exclude portions of the project area that have prescribed fire covered by previous NEPA decisions.

- The Upper Nez Ecoburn, 2013 authorized prescribed fire on acres that overlap with the Mud Creek project area. Within this area 2,070 acres were classified as warm dry and dry grass. These acres were excluded from prescribed fire activities in Mud Creek.

Proposed acres for **Prescribed Fire-Low Intensity and Maintenance 28,235 acres**

- 24,298 acres or 86% of the acres proposed for prescribed fire-low intensity or maintenance were identified as either medium or high priority for fuels treatments during the fuels prioritization assessment. Priority was based on individual stand's mean burn probability, percent crown fire activity, distance from structures and likelihood of a fire originating in the stand that might impact the community. Areas proposed for prescribed fire-low intensity or maintenance that were identified as a low priority for treatment are further from structures and are currently not predicted to exhibit crown fire. Although these areas are not the highest priority for treatment it is important to maintain those conditions and prescribed fire is the best option.
    - 12,110 Acres of Medium Priority
    - 12,188 Acres of High Priority
    - 3,937 Acres of Low Priority
- The following assumptions are to be considered for this activity:
    - The implementation of prescribed fire-low intensity & maintenance will likely occur over an extended time period, possibly 20 years. Annual averages are expected to range from 1,000-5,000 acres depending on burn windows. This activity may be used as a stand-alone treatment or as the final step in a series of activities depending on existing conditions. Prescribed fire-low intensity will be used following all intermediate commercial harvest to reduce natural and activity-created fuels. Fuelbreak and fireline construction activities will be used in conjunction with prescribed fire. During implementation planning, Lynx habitat criteria will be used to further refine acres available for low intensity fire to stay within policies and design feature thresholds.
    - Prescribed fire-site preparation is used in conjunction with regeneration harvests to facilitate the success of natural or artificial regeneration. It is assumed all acres proposed for regeneration harvest will have prescribed fire-site prep. Some of these acres likely will overlap with the areas identified for prescribed fire-low intensity or mixed severity.

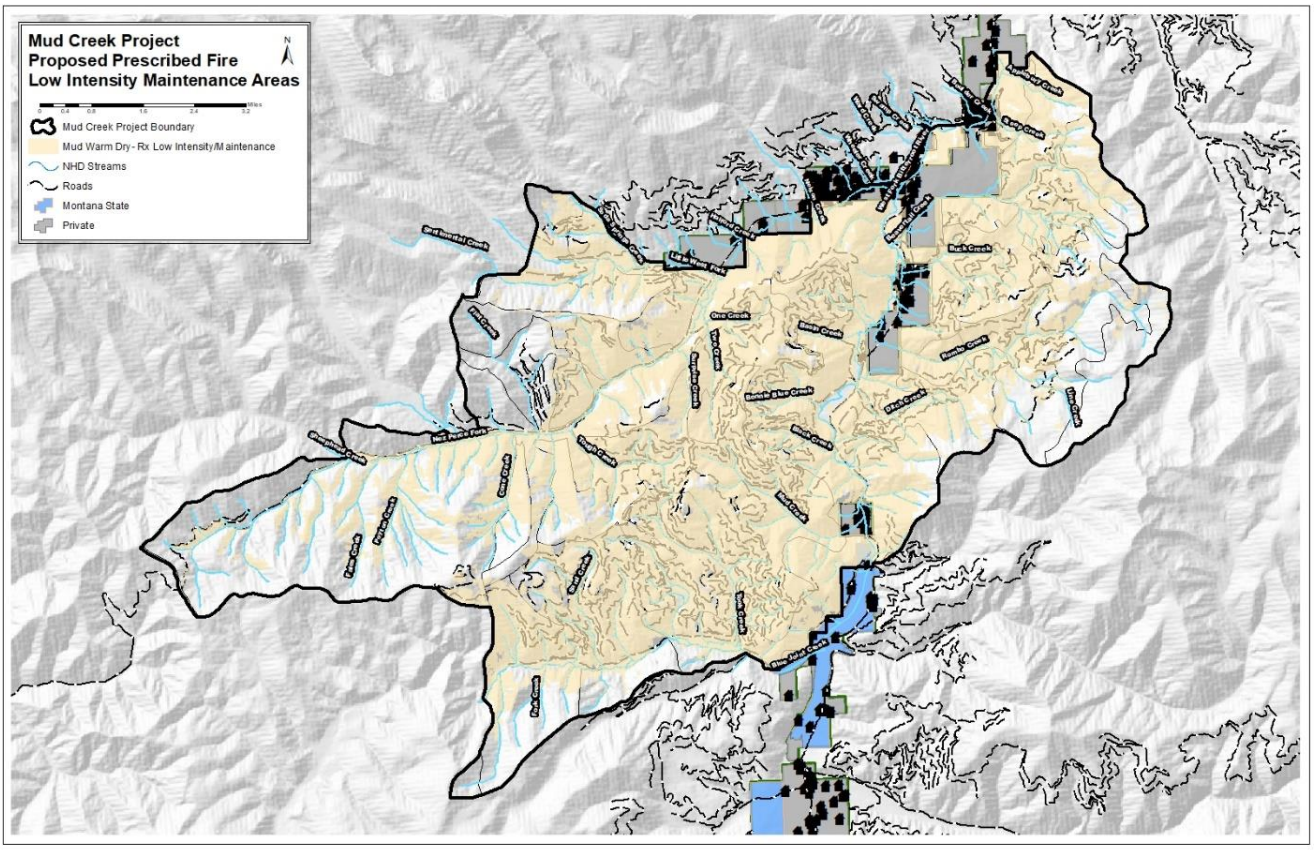

Figure 7. Proposed Prescribed Fire-Low Intensity & Maintenance

Mixed Severity/ Moderately Short Frequency Fire Regimes

Cool moist forest types comprise 12,245 acres or 26% of the project area. Historically, 26% of the project area is classified as being within Fire Regime Groups III, IV and V. These areas would have burned less frequently and with mixed or stand replacing fire. Arno found that these forest types still had relatively frequent fire return intervals and sometimes experienced low intensity fires. Mixed severity fire naturally would have provided landscape diversity in these areas by creating patches and patterns of vegetation that were varied in age, size and successional stage. This also would have resulted in a variety of fuels conditions and a lack of continuity across the landscape.

Where are cool moist forest types located?

- Within the Mud Creek Project Area 12,245 acres are classified as cool moist forest types. These forest types are dominated by lodgepole pine, subalpine fir, and spruce.

Exclude RHCA's from prescribed fire to protect water quality and aquatic habitat.

- A 50' buffer on either side of the NHD stream layer was used. Utilizing this filter ensures compliance with the fisheries design feature for prescribed fire that prohibits direct ignition within 50' of streams.

Exclude portions of the project area that have prescribed fire covered by previous NEPA decisions.

- The Upper Nez Ecoburn, 2013 authorized prescribed fire on acres that overlap with the Mud Creek project area. Within this area 672 acres were classified as cool moist. These acres were excluded from prescribed fire activities in Mud Creek.

Proposed acres for **Prescribed Fire- Mixed Severity 11,085 acres**

- 5,591 acres or 50% of the acres proposed for prescribed fire-mixed severity were identified as either a medium or high priority for fuels treatments during the fuels prioritization assessment. Priority was based on individual stand's mean burn probability, percent crown fire activity, distance from structures and likelihood of a fire originating in the stand that might impact the community. Areas proposed for prescribed fire-mixed severity that were identified as a low priority for treatment are further from structures and have lower burn probabilities because they are generally located on moister sites. These areas still exhibited a high probability of crown fire. Although these areas are not the highest priority for treatment, it is important to mimic natural processes in a controlled manner that will achieve the desired conditions for these forest types and the landscape. Implementing prescribed fire-mixed severity will provide opportunities to reduce the continuity of fuels and potential for fire behavior that is difficult to suppress while creating vegetation and landscape diversity.
    - 3,731 Acres of Medium Priority
    - 1,860 Acres of High Priority
    - 5,494 Acres of Low Priority

- The following assumptions are to be considered for this activity:
    - The implementation of prescribed fire- mixed severity will likely occur over an extended time period, possibly up to 20 years. In most of the proposed locations, it will be necessary for adjacent treatment activities to have been completed prior to provide control locations and reduce risk to off-site values. Annual averages are expected to range from 0-5,000 acres depending on burn windows. This activity will primarily be used as a stand-alone treatment. Fuelbreak and fireline construction activities will be used in conjunction with prescribed fire. Some of the acres identified for mixed severity may be treated by commercial harvest depending on location. If so, those areas would have mixed severity fire prescribed. It is likely prescribed fire-site preparation will be used instead. During implementation planning, ECA and Lynx habitat criteria will be used to refine acres available for mixed severity fire to stay within design feature thresholds.
    - Prescribed fire-site preparation is used in conjunction with regeneration harvests to facilitate the success of natural or artificial regeneration. It is assumed all acres proposed for regeneration harvest will have prescribed fire-site prep. Some of these acres likely will overlap with the areas identified for prescribed fire-mixed severity.

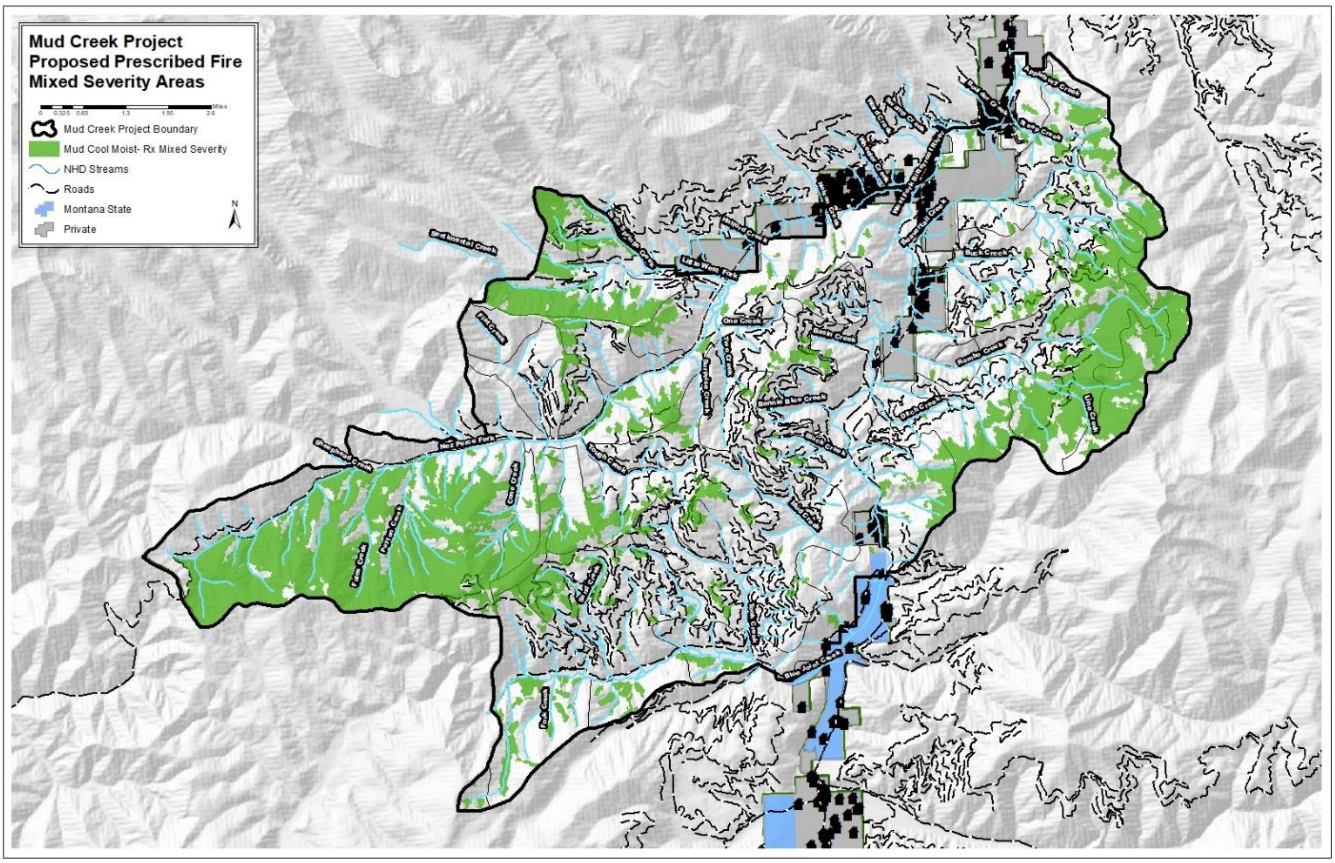

Figure 8. Proposed Prescribed Fire-Mixed Severity

Non Commercial Activities- Warm Dry Forest Types and Wildland Urban Interface (WUI)

As previously discussed, there is a moderate to significant departure of vegetation, fuels and potential fire behavior within the warm dry forest types that historically had frequent low intensity fire. Frequent fire disturbances primarily kept stand densities and fuel accumulations low. Warm Dry forest types comprise 31,503 acres or 68% of the project area. The wildland urban interface encompasses 20,841 acres within the Mud Creek project. Strategic management objectives for the WUI requires suppression of fires using aggressive initial attack actions because of the high values at risk and the high threat to life and property. For suppression to be effective there is also a need to reduce fuels and the potential fire behavior in cool moist forest within the WUI. The following criteria was used to filter out areas where non-commercial activities would be an appropriate activity to reduce fire behavior, protect communities, restore or maintain desired vegetation conditions and provide resilience to disturbance processes on the landscape.

Where are warm dry forest types located?

- Within the Mud Creek Project Area 31,503 Acres are classified as Warm Dry Forest. These areas are dominated by ponderosa pine, dry-Douglas-fir.

Where are the cool moist forest types located within the WUI?

- Within the Mud Creek WUI there are 731 acres of Cool Moist Forest. These areas are located in critical locations where it is necessary to reduce potential fire behavior in order to limit impacts to adjacent communities, infrastructure and highly valued resources, while improving firefighter safety and providing flexibility during wildfire management.

Exclude RHCA's from non-commercial activities to maintain shade, protect water quality and aquatic habitat.

- A 50' buffer on either side of the NHD stream layer was used. Utilizing this filter ensures compliance with the fisheries design feature for non-commercial activities that prohibits tree thinning, piling and pile burning within 50' of streams.

Exclude portions of the project area where non-commercial activities are prohibited by the Forest Plan.

- All Forest Plan management areas (MA1, 2, 3A, 5 & 8A) within the project area allow non-commercial activities. However, approximately 7,718 acres are within the Blue Joint Wildness Study Area (WSA) which restricts these activities. Within the Blue Joint WSA 2,135 acres were classified as warm dry forest. Within the Inventory roadless areas 133 acres of warm dry forest was identified. These acres were excluded from proposed non-commercial activities.
- The project area includes portions of the Selway Bitterroot, Blue Joint and Allen Mountain IRA's. Within these Inventory roadless areas, 133 acres of warm dry forest was identified for potential non-commercial treatments. Most of these areas were small and isolated. The acres of warm dry forest within the IRA were excluded from proposed non-commercial activities.

Exclude portions of the project area that have non-commercial activities covered by previous NEPA decisions.

- The Upper Nez Ecoburn, 2013 authorized prescribed fire and non-commercial activities on acres that overlap with the Mud Creek project area. Within this area 1,996 acres were classified as warm dry forest. These acres were excluded from proposed non-commercial activities in Mud Creek.

Final Acres Proposed for **Non-commercial activities 26,282 acres**

- 23,847 acres or 90% of the acres proposed for non-commercial activities were identified as either medium or high priority for fuels treatments during the fuels prioritization assessment. Priority was based on individual stand's mean burn probability, percent crown fire activity, distance from structures and likelihood of a fire originating in the stand that might impact the community. Areas proposed for non-commercial activities that were identified as a low priority for treatment are further from structures. Although these areas are not the highest priority for fuels treatment they are still departed from desired conditions based on their fire regime and forest type.
    - 11,227 Acres of Medium Priority
    - 12,620 Acres of High Priority
    - 2,435 Acres of Low Priority

- The following assumptions are to be considered for this activity:
    - The implementation of non-commercial activities will likely occur over an extended time period, possibly up to 20 years. Annual averages are expected to range from 500-4,000 acres depending on funding. These activities are likely to be completed as intermediate treatments prior to the reintroduction of prescribed fire, specifically areas targeted for low intensity. The exact combination of activities will be dependent on existing conditions, the desired conditions and proximity to values. During implementation planning, Lynx habitat criteria will be used to further refine acres available for non-commercial activities to stay within policies and design feature thresholds. The proposed areas include plantations from previous timber management that have been identified for stand improvement needs as part of the Silviculture prioritization process.

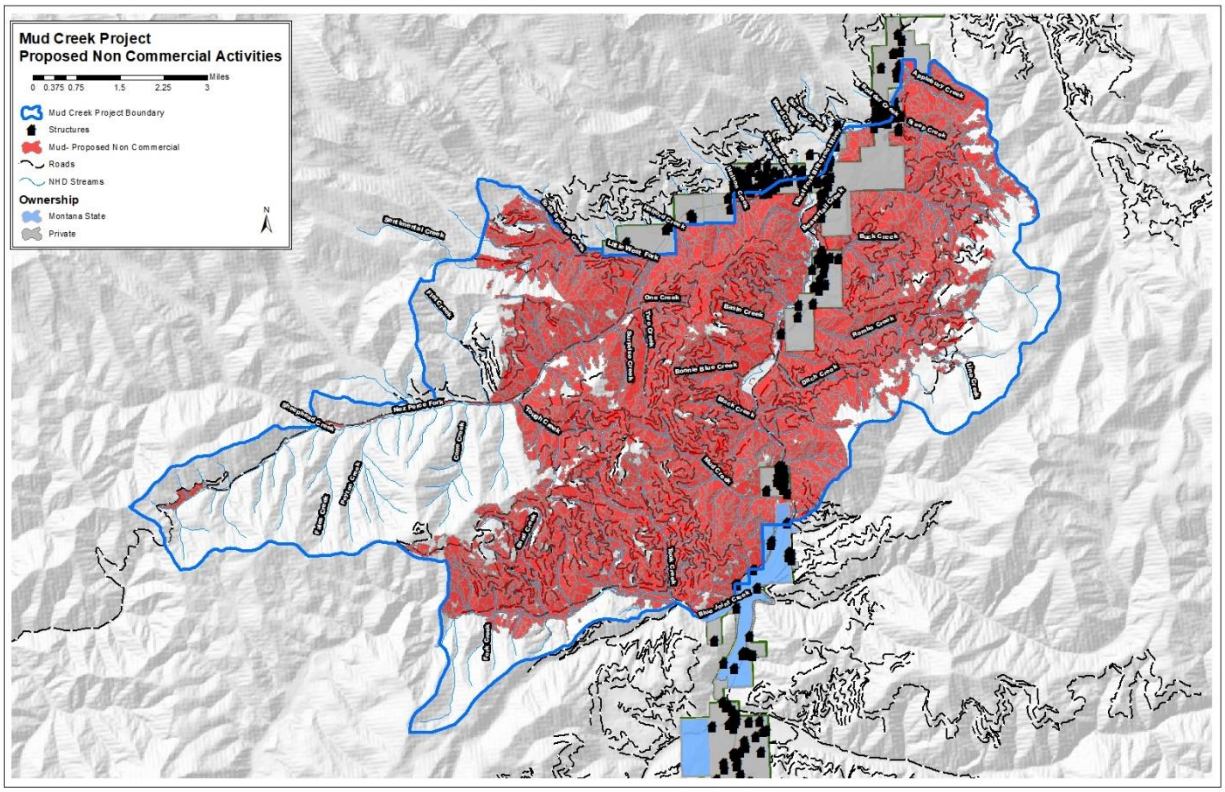

Figure 9. Proposed Non-Commercial Activities

Final Summary of Proposed Fuels Activities

Table 6: Summary of Proposed Prescribed Fire and Non-Commercial Activities

Activity	Max Acres
Prescribed Fire-Low Intensity & Maintenance	28,235
Prescribed Fire-Mixed Severity	11,085
Prescribed Fire-Site Preparation	4,800
Non Commercial Activities (SI-Thinning/Slashing, Piling, Pile Burning)	26,282